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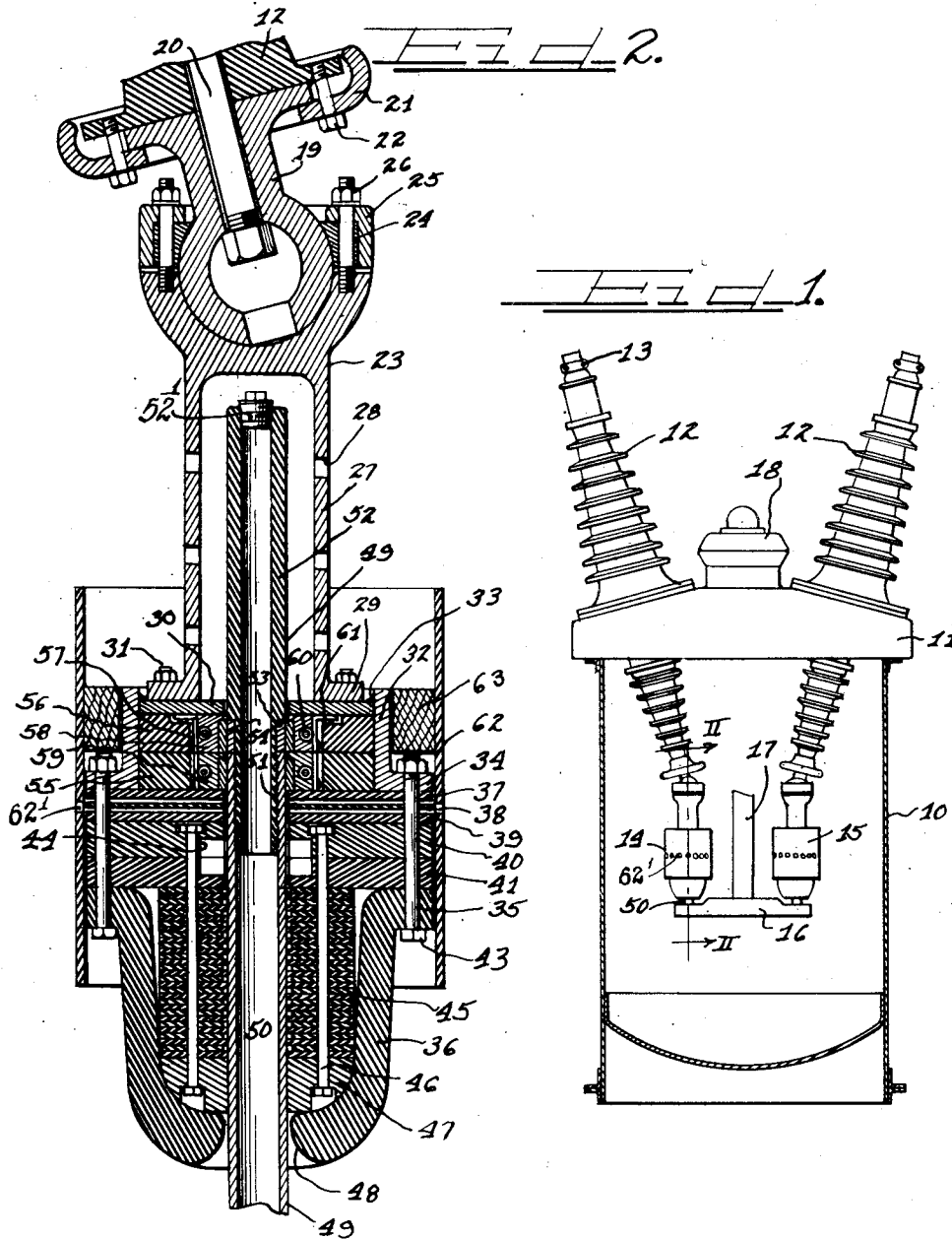
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CIRCUIT BREAKER

Filed Nov. 15, 1934

2 Sheets-Sheet 1



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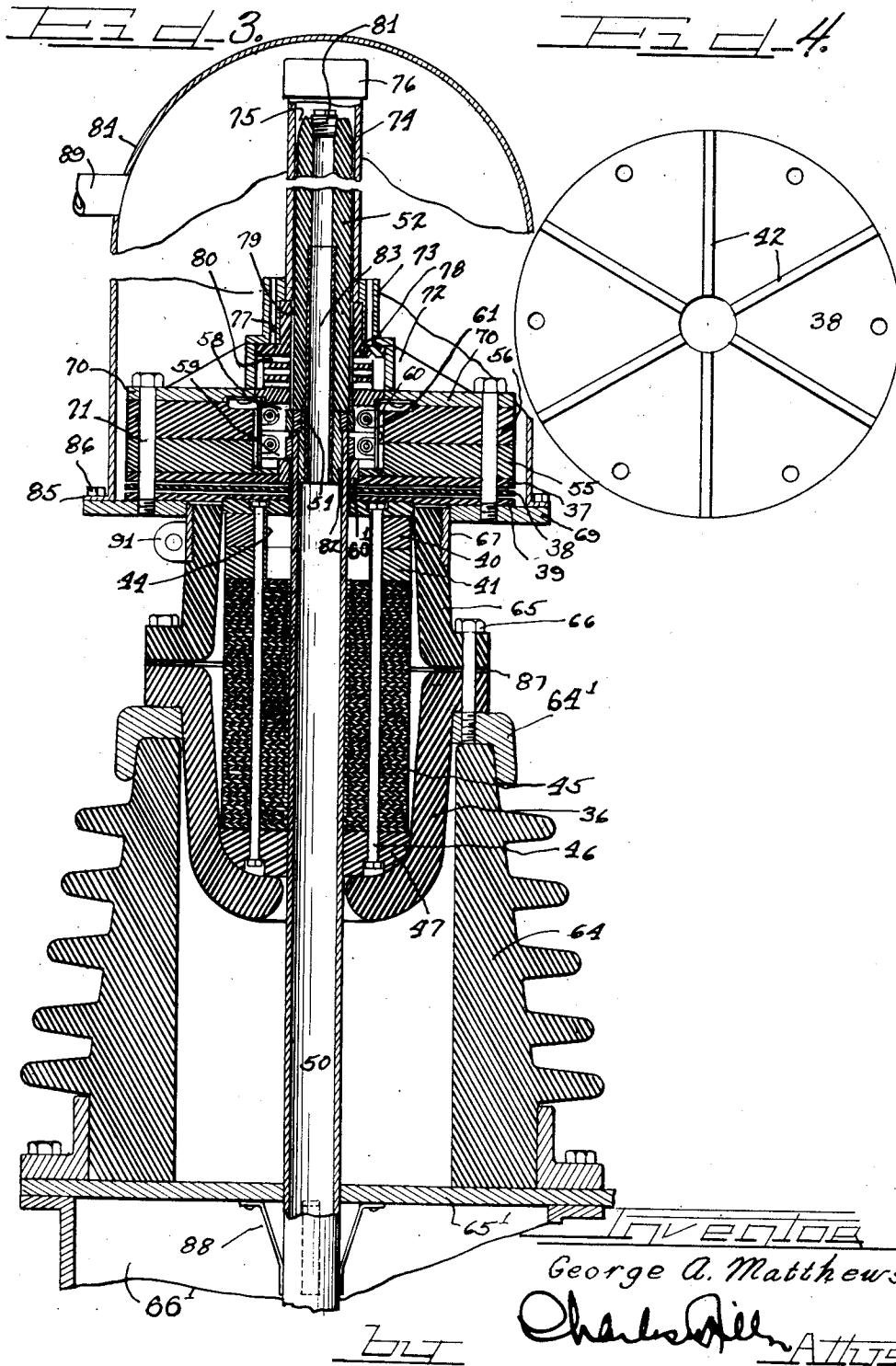
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UNITED STATES PATENT OFFICE

2,118,355

CIRCUIT BREAKER

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15 Claims. (Cl. 200—149)

This invention relates in general to circuit breakers and is more particularly concerned with improved means for extinguishing the arc that is formed during the opening of the circuit breaker contacts under load.

Circuit interrupting devices for opening electrical circuits under load have heretofore been constructed wherein the arc has been interrupted in an atmosphere of hydrogen or other gas having a de-ionizing effect upon the arc. Moreover, it has been found that the diameter of the arc is one of the primary factors influencing the speed of the de-ionization of the arc and hence its extinguishment in the vicinity of the current zero period: the smaller the arc diameter, the more rapid the de-ionization.

According to recent investigations an arc in hydrogen burns at a much smaller diameter than an arc in air, for identical currents. It has also been known that an arc in air can be forced to burn at a small diameter by subjecting it to a high velocity air blast. It will, therefore, be evident that by combining these two conditions, that is, subjecting the arc to a blast of hydrogen, the smallest diameter and the most effective de-ionization of an arc for a certain current may be obtained.

In the well known expulsion fuse, the deionizing gas is obtained through the decomposition of an organic material such as horn fiber by the action of the electric arc, and in the conventional oil circuit breaker the deionizing gas results from the decomposition of oil. Many devices have been used for forcing the hydrogen at high velocity through the arc, as for example, the conventional explosion chamber. Due to its construction, however, the ordinary explosion chamber has been unsatisfactory as to arcing time, arc energy, and capacity to interrupt small currents.

Improvements in the explosion pot have therefore been suggested and tried with more or less success in an effort to overcome its inherent disadvantages. Principally among these improvements is the so-called expulsion oil circuit breaker which seeks to combine the operating principles of the expulsion fuse with those of the conventional explosion pot. One such arrangement includes a main chamber containing the separable contacts, and an adjacent expulsion tube having an expulsion opening through which the arc is forced by the movement of the gas blast there-through. This arrangement has several disadvantages: The contacts are so disposed that the gas pressures subject the moving contact to forces which are so distributed as to cause unbalancing

of the part, and the movement of the movable contact within the chamber during the opening operation tends to change the volume of the de-ionizing gas.

To overcome the foregoing disadvantages, the present invention proposes to provide an improved structure wherein the volume of the chamber is maintained substantially constant during the movement of the movable contact, and in which the pressures generated by the deionizing gas act substantially at right angles to the movement of the movable contact, whereby a balanced rather than an unbalanced condition is effected.

A further object is to provide a circuit breaker of such design and construction that it may be utilized as a dry or oil type, depending upon the operating conditions required to be met.

As a further object, it is proposed to provide a circuit breaker having improved arc extinguishing qualities, and which is so constructed as to be readily adapted for pole or tank mounting.

Still another object resides in the provision of a circuit breaker of the expulsion type, wherein the deionizing fluid will not recede as the contact is withdrawn relative to the arcing chamber.

Other objects and features of the invention will more fully appear from the following detailed description taken in connection with the accompanying drawings, which illustrate several embodiments thereof, and in which

On the drawings:

Figure 1 is a view in elevation partly in section of a conventional type oil circuit breaker, having circuit interrupting parts embodying the principles of the present invention;

Figure 2 is an enlarged sectional view showing the arrangement of the circuit breaker contacts and surrounding parts, taken substantially on line II—II of Figure 1;

Figure 3 is an enlarged sectional view showing a modification of the arrangement shown in Figure 2, whereby the circuit breaker is adapted for pole mounting; and

Figure 4 is a detailed view showing the construction of one of the insulating discs utilized in the circuit breaker.

As shown on the drawings:

In the illustrated embodiment of the present invention there is shown in Figure 1 a tank type circuit breaker of the usual type, which has been modified to embody the present invention. The tank type circuit breaker comprises the usual tank 10 having a cover 11 which has mounted therein high tension insulators 12—12. Outside

of the cover each insulator is provided at its upper end with a suitable terminal 13 to which the electric circuit in which the breaker is to be used may be connected.

5 The drawings disclose the switching arrangement of one phase of a multi-phase circuit, as embodied in a double break circuit breaker. Within the tank, the stationary contact elements are, as indicated at 14—15, supported from the
10 lowermost end of the insulators. The moving contacts are supported from a bridging member 16 which is operated through the agency of an operating member 17 which is supported for vertical movement by an operating mechanism 18
15 mounted on the circuit breaker cover 11. The power mechanism for actuating the movable contacts may be of any desired construction.

In the usual circuit breaker, the tank 10 would be filled with oil to a level above the support for
20 the stationary contacts.

More specifically, the details of the contact mechanism and the support for each of the stationary contacts, is disclosed in Figure 2. Each stationary contact is adjustably supported at the
25 lower end of one of the insulators by means of a ball and socket joint connection, whereby the stationary contacts may be adjusted and secured in proper alignment.

For this purpose, the ball and socket joint includes a ball casting 19 which is swivelly suspended relative to a conductor 20 which passes through the insulator from the line terminal thereon. Once the desired position of the ball casting 19 is ascertained, it is clamped in adjusted position by means of a clamping member
35 21 and securing bolts 22. A socket casting 23 for cooperation with the ball casting is provided with a removable annular socket forming member 24 which is secured to the main socket casting by means of an annular ring or collar 25, this collar
40 or ring being secured in clamping position by stud bolts 26. With this arrangement, it will be evident that the entire stationary contact mechanism may be readily removed from the
45 lower end of the insulators, simply by removing the securing nuts from the bolts 26 which enables the ring 25 and member 24 to be removed to release the contact assembly relative to the ball casting.

The socket casting 23 is extended to form a tubular casing or housing 27 having a plurality of openings 28 extending through the wall thereof. The lowermost end of the housing portion of the casting 23 is deflected to form an outstanding flange 29. A plate member 30 is secured
55 across the open end of the tubular housing by means of a bolt and nut connection 31, the bolts of these connections extending through the flange 29.

The housing for the stationary contacts is formed by a metallic annular member 32 which is secured at its upper end to the plate 30 as by welding or other desirable means, the welding being shown at 33. The lower end of the member
60 32 is outwardly deflected to form an abutment flange 34.

The abutment flange 34 also serves as a clamping surface to cooperate with a flange 35 on a bell shaped member 36 which is constructed of
70 a phenol-resin compound.

Clampingly secured between the flanges 34 and 35 are a plurality of disc shaped members 37—38—39—40 and 41. The discs 37—38 and 39 are spaced apart to form radially extending passageways. The spacing may be accomplished by
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constructing disc 38 in the manner shown in Figure 4, that is, providing radially extending ribs 42 on both surfaces of the disc. It is evident that these ribs will bear against discs 37 and 39 and hold them in spaced relation. The discs and
5 members 40 and 41 are clampingly secured between the flanges 34 and 35 by means of a plurality of clamping bolts 43.

Members 40 and 41 may be constructed of solid pieces of organic material such as horn fiber, or if desired may be built up of laminae. In either case the central portions of the members 40 and 41 cooperate to form an annular pocket or recess 44.
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Extending below the members 40 and 41 and within the bell shaped member 36, there is provided a plurality of discs 45 of organic material. The discs 45 are in stacked relation and are clamped by means of clamping bolts 46 between an outer clamping member 47 at the lower end
15 of the stack and member 41 at the upper end of the stack.

The lower end of member 36 is apertured at 48, and in axial alignment with this aperture the member 47, discs 45, members 40—41, discs 39, 38 and 37 and the metal plate 30 are all centrally apertured to provide a longitudinal chamber or passageway for receiving there-
20 through a moving contact rod assembly 49.

The rod assembly 49 comprises a metallic tubular portion 50 which is internally threaded at its upper end for connection to a contracted threaded portion 51 of a tubular extension 52 formed of organic material such as horn fiber and closed at its upper end by a plug 52'.
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The contracted portion 51 of the extension defines a shoulder 53 which clampingly cooperates with the upper end of section 50 to clampingly engage an annular contact member 54 which is thereby secured to and movable with the rod assembly.
30

Surrounding the rod assembly and disposed within the member 32 are ring shaped members 55 and 56 of organic insulating material such as horn fiber, these members defining a central cavity 57 for the stationary contacts. The stationary contacts comprise an upper set 58 and a lower set 59, each set comprising a plurality of segmental portions fitted together to form a ring. These portions are pressed inwardly towards the rod assembly by means of a circumferentially extending coil spring 60. The two sets of contacts are inter-connected by flexible conducting straps 61 which are electrically connected to the metallic plate 30.
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From the drawings, it will be noted that the inner peripheries of the stacked members 45 are in staggered relation so as to form an irregular surface around the rod assembly. Moreover it will be evident that the clearance between this surface and the rod is much smaller than the clearance between the members disposed above the pocket 44 and the rod.
40

Disposed around the contact assembly is a cylinder 62 of insulating material. This protecting cylinder is supported by an internal ring or block of wood 63 which is fixedly secured to the cylinder and rests upon the ends of clamping bolts 43, the cylinder and ring being held in position by their inherent weight. The cylinder 62 adjacent the outer ends of the radial passageways between the discs 37—38 and 39 is provided with a series of openings 62' for the passage of oil.
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From the foregoing description it will be apparent that as the rod assembly is moved down-
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wardly in an axial direction, the contact 54 will slide along the stationary contact members and as the rod is moved still further, the movable contact will be moved out of engagement with the lowermost set of stationary contacts. Since the circuit breaker is opened as a rule under load conditions, an arc will be formed when the stationary and moving contacts are moved out of circuit closing position. This arc will be extended into the pocket 44 and cause the oil therein to be decomposed and give off a deionizing gas. The gas pressure due to the decomposed oil will initially be localized within and above the pocket 44, thereby setting up a pressure in all directions. The pressure surrounding the rod being equalized since the rod is of constant diameter and extends both above and below the region of pressure, movement of the rod will not be interfered with and a balanced condition will result as the gas pressure on the outer surface of the rod is the same at all points of the circumference of the rod.

Moreover, the resistance of the flow of this gas downwardly through the stacked discs 45 along the rod assembly is much greater than the resistance to the flow of gas in an upward direction along the rod from the pocket 44. Consequently the arc will be carried upwardly and will be spread out in the space between the rod and the surrounding discs of organic material. The resulting action will cause a gas blast similar to the action taking place in an expulsion fuse.

It will also be noted that due to the fact that the extension 52 extends above the stationary contacts, the rod assembly may be moved downwardly without appreciably changing the volume of the arcing chamber. Also in the case where the contact assembly is located in oil, there will be little or no tendency of the oil to recede due to the downward movement of the rod assembly as would be the case in the ordinary type of explosion pot.

Due to light mass of the rod assembly, it will be apparent that it will only necessitate a small amount of power to operate the contacts from closed to open and open to closed position.

In Figure 3 there is disclosed a modified form of circuit breaker which operates on the same principle as the hereinbefore described embodiment of the invention. In the modified form like numerals have been used to indicate the corresponding parts.

The embodiment shown in Figure 3 is also of slightly different construction in part to adapt the same for pole mounting. The operating mechanism is not disclosed, since it forms no part of the present invention and any desired type of mechanism may be employed for the actuation of the movable contact.

The breaker parts are, in this case, supported upon an insulator 64, the lower end of this insulator being secured to a plate structure indicated by the numeral 65 of metallic material, and which may form a closure for one end of a closed tank or container 66'. The upper end of the insulator is secured in an adapter ring 64' as by means of cement, this ring being secured to the bell shaped member 36 and an extension member 65 of a phenol-resin compound by means of bolts 66. The extension 65 enables the stack of laminations 45 to be considerably lengthened.

The upper end of the extension member 65 is provided with an enforcing ring 67 which is secured to a plate member 69 which cooperates with an upper clamping member 70 through clamping

bolts 71 to clampingly secure the members 55, 56, 37, 38, and 39 in operative position. The stationary contact arrangement is the same as in the previously described form of the invention, except that an annular arcing ring 60' is disposed below the lowermost stationary contact 59. This arcing ring is electrically connected to the flexible conductor straps 81.

The upper clamping plate is provided with radially extending ribs 72 which converge to a central housing 73 which vertically supports a metallic tubular member 74 defining a chamber 75 closed at its upper end by cap 76.

The housing member 73 is provided with longitudinally extending passageways 77 which communicate with the inside of the housing. There is also within this housing a tubular fitting of organic material such as horn fiber. This fitting is provided with an axial passageway 79 which is in communication with radial passageways 80 which cooperate with the passageways 77 to connect the space surrounding the rod extension 52 with the interior of the housing 84.

Moreover, the upper end of the extension is closed by means of a plug 81 and it will be noted that the extension 52 is connected to the metallic tubular portion 50 in a slightly different manner.

In this regard, an internally threaded plug 82 is secured in the upper end of the tubular portion 50 and a tubular connector 83 is provided with threads at one end for threadedly engaging the extension 52 and with threads at its other end for threadedly engaging the internal threads of the plug 82. The movable contact 54 is clamped between the portion 50 and the extension 52 as in the previous case and may also be soldered to plug 82 to secure a good electrical contact.

A housing 84 is provided with an outwardly extending flange 85 and is apertured to receive a plurality of securing bolts 86 which are threaded into the plate 69. This housing totally encloses the portion of the mechanism above the plate 69, and the arcing chamber is housed within the extension 65 and the bell shaped member 36, a suitable gasket 87 being provided at the juncture between these two members.

It will be noted that the stationary contacts in this case are connected to a flexible conductor 61 through the plate 70 and that a circuit through the stationary and movable contacts is completed through the metallic rod portion 50 to frame 65 by means of spring contacts 88 which are supported on the frame 65 and engage the rod 50 during its movement.

The space within the housing 84 provides an expansion chamber for gases which might be generated during the opening of an electrical circuit. On the other hand, additional expansion space may be provided through a connection 89 which may connect into this housing at any desired point.

The circuit breaker may under different conditions be operated either as an oil type or a dry type breaker. In the case oil is used, oil would extend into the expansion chamber within the housing 84.

One terminal of the electrical circuit in which the breaker is to be installed may be connected to a lug 91 or any portion of the metallic structure which is not insulated from this lug, for example, the terminal could be connected to any portion of the housing 84 with equal facility. The other terminal would be to a portion of the frame 65 or any metallic part in electrical connection therewith.

From the foregoing description, it will be apparent that the present invention provides an improved circuit breaker of the expulsion type, which may be operated, depending upon required conditions, either as a dry type or oil type breaker; a breaker in which the delonizing fluid does not recede when the contacts are opened; a breaker which is adapted with slight modifications for pole or tank mounting; and which has improved arc extinguishing qualities. Moreover, the improved breaker of this invention is so constructed that the forces resulting from fluid pressure during the arc interruption will produce a balanced rather than unbalanced condition.

Now, it is of course to be understood that although I have described in detail several embodiments of my invention, the invention is not to be thus limited but only insofar as defined by the scope and spirit of the appended claims.

I claim as my invention:

1. A circuit breaker of the character described comprising a substantially tubular chamber having an enlarged portion defining a pocket and adapted to contain an arc extinguishing fluid, an elongated contact actuating member disposed in said chamber and adapted for axial movement thereof, a stationary contact in said chamber and spaced from said pocket by a tubular chamber wall formed of material capable of evolving an arc extinguishing medium when contacted by an arc, a cooperable contact carried by said actuating member, and a rod extension carried by said actuating member beyond said cooperable contact for movement therewith to maintain the volume of said chamber constant during a circuit breaking movement of said actuating member, said rod extension being of insulating material capable of evolving an arc extinguishing medium when contacted by an arc.

2. A device of the character described comprising a tubular arcing chamber open at both ends, said chamber having an enlarged portion defining a pocket, an elongated contact actuating member extending into said chamber and movable axially thereof, a stationary contact in said chamber and spaced from the pocket, a cooperable contact at one end of said member adapted to be moved through the chamber by said member from the stationary contact to the pocket portion to open an electrical circuit through the contacts and cause the arc, due to the separation of the contacts, to be interrupted in the pocket portion, and an extension on said member extending beyond said movable contact to maintain the volume of said chamber substantially constant during the opening of said circuit, said extension and the tubular chamber wall between said stationary contact and said pocket being formed of material capable of evolving an arc extinguishing medium when contacted by an arc.

3. A device of the character described comprising a tubular arcing chamber open at both ends, said chamber having an enlarged portion defining a pocket, an elongated contact actuating member extending into said chamber and movable axially thereof, a stationary contact in said chamber and spaced from the pocket, a cooperable contact at one end of said member adapted to be moved through the chamber by said member from the stationary contact to the pocket portion to open an electrical circuit through the contacts and cause the arc, due to the separation of the contacts, to be interrupted in the pocket portion, and an extension on said member extending beyond said movable contact to main-

tain the volume of said chamber substantially constant during the opening of said circuit, said chamber and extension having facing surfaces of a material adapted to emit an arc extinguishing medium under the influence of an electric arc.

4. A device of the character described comprising a substantially tubular chamber having open ends, said chamber having an enlarged portion intermediate its ends defining a pocket, an elongated rod member extending through said chamber, a stationary contact spaced from said pocket, a cooperable contact carried by said rod member and movable out of engagement with said stationary contact to the pocket portion, whereby any arc formed during the separation of the contacts will be drawn into said pocket, said rod member including a non-conducting section extending beyond said cooperable contact to maintain the arcing space within said pocket of constant volume as the contacts separate, means in said pocket adapted to emit an arc extinguishing medium under the action of an electrical arc and create a pressure tending to force the medium outwardly from said pocket axially of said rod member, the resistance to such axial flow of said medium being greater in one direction from said pocket than in the other.

5. A device of the character described comprising a substantially tubular chamber of organic insulating material having open ends, said chamber having an enlarged portion intermediate its ends defining a pocket, an elongated rod member extending through said chamber and pocket, a stationary contact adjacent said pocket, a cooperable contact carried by an intermediate portion of said rod member and movable out of engagement with said stationary contact to the pocket portion, whereby any arc during the separation of the contacts will be drawn into said pocket, means in said pocket adapted to emit an arc extinguishing medium under the influence of an electrical arc and create a pressure tending to force the medium outwardly from said pocket to flow axially of said rod member towards the open ends of said tubular chamber, the clearance between the rod member and the walls of said tubular chamber being less at that side of the pocket remote from the stationary contact than at the other side thereof, whereby the flow of the medium axially of the rod is greater in the direction opposite to the movement of the rod member to separate said contacts.

6. A device of the character described comprising a substantially tubular chamber of organic insulating material having open ends, said chamber having an enlarged portion intermediate its ends defining a pocket, an elongated rod member extending through said chamber, a stationary contact adjacent said pocket, a cooperable contact carried by and spaced from the free end of said rod member, the portion of the rod member beyond said cooperating contact being moved into said pocket and the section of said tubular chamber adjacent said stationary contact during a contact-separating movement of the rod member, and movable out of engagement with said stationary contact to the pocket portion, whereby any arc during the separation of the contacts will be drawn into said pocket, means in said pocket adapted to emit an arc extinguishing medium under the influence of an electrical arc and create a pressure tending to force said medium outwardly from said pocket axially along said rod member in the direction opposite that of contact-separating movement of said rod mem-

ber, and means responsive to the disengagement of said contacts to augment the flow of arc extinguishing medium in said direction.

7. A device of the character described comprising an elongated chamber of organic insulating material closed at one end, said chamber having an enlarged portion defining a pocket intermediate its ends, a reciprocable rod member in said chamber and having a free end extending into said closed end portion, cooperable contacts in said chamber between said pocket and said closed end, one of said contacts being carried by said rod member and so spaced from the free end thereof that said free end remains within said pocket and adjacent section of the elongated chamber when the contacts are separated, and means within said chamber and pocket adapted to emit an arc extinguishing medium under the influence of an electric arc, said closed end portion of the chamber and the associated portion of the rod acting, during the separation of said contacts, to cause a decreased pressure which tends to move the arc extinguishing medium from said pocket portion towards the closed end portion of said chamber.

8. A device of the character described comprising a substantially tubular chamber of organic insulating material having open ends and an enlarged portion defining a pocket, and a reciprocable rod member extending through said pocket portion of the chamber in all operative positions of the rod member, and cooperable contacts in said chamber, one of said contacts being supported on and movable with said rod member to a circuit-open position within the pocket portion of said chamber, the wall of said chamber on one side of said pocket having a greater clearance relative to said rod member than the wall on the other side of said pocket.

9. A device of the character described comprising a substantially tubular chamber of organic insulating material having open ends and an enlarged portion defining a pocket, a reciprocable rod member extending through said pocket portion of the chamber in all operative positions of the rod member, and cooperative contacts in said chamber, one of said contacts being supported on and movable with said rod member to a circuit-open position within the pocket portion of said chamber, the wall of said chamber on the side of the contacts, when engaged, having a greater clearance relative to said rod member than the wall on the other side of the pocket.

10. A device of the character described comprising a substantially tubular chamber of organic insulating material having open ends and an enlarged portion defining a pocket, a reciprocable rod member extending through said chamber and pocket in all operative positions of the rod member, cooperable contacts in said chamber carried respectively, by the chamber wall and by said rod member, the wall of said chamber on one side of said pocket presenting a smooth surface and the wall on the other side of the pocket presenting an irregular surface.

11. A device of the character described comprising

a substantially tubular chamber of organic insulating material having open ends and an enlarged portion defining a pocket, a reciprocable rod member extending through said chamber and pocket in all operative positions of the rod member, and cooperative contacts in said chamber, one of said contacts being carried by said rod member, the wall of said chamber on one side of said pocket presenting a smooth surface, and the wall on the other side of the pocket presenting a grooved surface.

12. A device of the character described comprising a substantially tubular chamber of organic insulating material having open ends and an enlarged portion defining a pocket, a reciprocable rod member extending through said chamber and pocket in all operative positions of the rod member, and cooperative contacts in said chamber, one of said contacts being carried by said rod member, the wall of said chamber on one side of said pocket presenting a smooth surface, and the wall on the other side of the pocket presenting a grooved surface, said grooves extending circumferentially relative to said rod member.

13. A device of the character described comprising a substantially tubular chamber of organic insulating material having an open end and an enlarged portion defining a pocket, a reciprocable rod member extending through said chamber and pocket in all operative positions of the rod member, cooperative contacts in said chamber, one of said contacts being carried by said rod member, and vent passageways communicating with the wall of said chamber contiguous the closed position of the contacts.

14. A device of the character described comprising a substantially tubular chamber of organic insulating material having open ends and an enlarged portion defining a pocket, a reciprocable rod member extending through said chamber and pocket in all operative positions of the rod member, cooperative contacts in said chamber, one of said contacts being carried by said rod member, and vent passageways communicating with the wall of said chamber contiguous the closed position of the contacts, said passageways being disposed on either side of the closed contacts.

15. A circuit breaker comprising insulating material defining a tubular passage having an enlargement forming a pocket intermediate the ends of the passage, contact means projecting into the passage at a point spaced from said enlargement, a movable contact for engagement with said contact means to complete a circuit, and means for moving said contact axially of said passage and through said pocket to open said circuit, and a member of insulating material secured to said contact and movable therewith in said passage to maintain the volume thereof constant during separation of said contact from said contact means, said member being of insulating material capable of evolving an arc extinguishing medium when contacted by an electric arc.

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